

Wood Frog

Rana sylvatica

DESCRIPTION

The wood frog is one of the smaller ranids inhabiting the northeast. Like the spotted and Jefferson salamanders, it is considered an obligate vernal pool amphibian species because it requires (or, more-accurately, prefers) vernal pools for breeding (Colburn 1995, Kenney 1995). The wood frog's life cycle includes an aquatic larval stage and terrestrial juvenile and adult stages (Berven 1990).

BODY SIZE

Wright and Wright (1949) reported lengths of wood frogs to be 34 – 60 mm for males and 34 – 78 mm typical, but up to 83 mm for females.

In The Primary Study Area: Body size data from the Housatonic vernal pool surveys are presented in Table 1.

Table 1. Body size data for adult and yearling wood frogs from 1999 live trapping surveys at vernal pools in the Housatonic study area

Parameter	Males	Females
Weight (g)		
Mean	11.2	17.6
Range	4.3–20.4	2.8–29.3
Std. Dev.	2.4	5.1
n =	265	169
Length (mm)		
Mean	47.7	54.4
Range	38.2–60.0	34.6–62.3
Std. Dev.	3.0	3.9
n =	265	169

DISTRIBUTION

The wood frog is one of the more cold-adapted amphibians, with a transcontinental range, occurring farther north than any other North American amphibian species (Figure 1). It can be found from the Canadian Maritimes west to Alaska, with southern portions of its range extending from southern Minnesota and Wisconsin to Arkansas, Tennessee and northern



Photo By R.D. Roy



Figure 1. Range of wood frog in North America

South Carolina to Maryland (Wright and Wright 1949). The wood frog is found farther north than any other North American reptile or amphibian, and is the only frog found north of the Arctic Circle. Some taxonomists recognize a “northern wood frog” subspecies (*R. sylvatica cantabrigensis*), but it is thought to occur only north of northern Maine into Quebec (Hunter *et al.* 1999).

MIGRATION

Wood frogs do not migrate except to move from aquatic breeding habitats to nearby terrestrial forest

habitats. In one study, dispersal distances of juvenile wood frogs from the natal pools averaged 1,169 m (\pm 351, N=66). The same study found that wood frogs appear to have excellent homing ability and that a high percentage of the juveniles returned to their natal pond to breed as adults (Berven and Grudzien 1990).

HABITAT

Wood frogs are entirely terrestrial except during the brief breeding season, when they move to vernal pools and other aquatic habitats to mate and lay eggs (DeGraaf and Rudis 1983, Hunter *et al.* 1999, Wright and Wright 1949). Their preferred terrestrial habitats are cool, moist upland woods, often far from water. They may also be found in wooded swamps and bogs. Wyman (1988) reported that adult wood frogs preferred to occupy moist sites near seeps, ponds, and small streams, and their distribution was not influenced by soil pH as were other amphibian species in that study (i.e., American toad, spotted salamander, northern redback salamander, northern two-lined salamander, and northern dusky salamander). In a New

Hampshire study, DeGraaf and Rudis (1990) found that wood frogs were more abundant than would be expected in streamside red maple stands versus upland red maple stands.

In summer, wood frogs are active day and night. They tend to use brush piles and other terrestrial features for cover, rather than seeking aquatic escape like some other frogs. During winter (October through March in the northeast), wood frogs hibernate in upland areas under rotting wood, moss, stones, or decaying leaf litter, never in water. The preferred breeding habitat is the vernal pool, though they will also utilize ditches, cattail swamps, gravel pits, slow-moving streams, and other ephemeral habitats that lack fish (DeGraaf and Rudis 1983, Hunter *et al.* 1999, Petranksa *et al.* 1994). Wood frogs show a greater tolerance for pond water with low pH when compared with the spotted salamander, with which it often shares the breeding pool (Rowe and Dunson 1993).

In The Primary Study Area: Data on habitat use by wood frogs from the Housatonic eco-characterization and vernal pool studies (1998 – 2000) are presented in Table 2.

Table 2. Habitat use by wood frogs in the Housatonic study area from 1998-2000 survey data

Habitat Codes and Natural Community Classifications																					
Wetland Habitats											Terrestrial Habitats										
ROW	ROW & PAB	SHO		PFO				PSS	PEM		WM	VP	SW	MW	HW		OF	AGR	RES		
Medium-gradient stream	Low-gradient stream	Riverine pointbar and beach		Mud flat	Red maple swamp	Black ash-red maple-tamarack calcareous seepage swamp	Transitional floodplain forest	High-terrace floodplain forest	Shrub swamp	Deep emergent marsh	Shallow emergent marsh	Wet meadow	Woodland vernal pool	Spruce-fir-northern hardwood forest	Northern hardwoods-hemlock-white pine forest	Successional northern hardwood forest	Red oak-sugar maple transitional forest	Rich mesic forest	Cultural grassland	Agricultural cropland	Residential development

ROW = Riverine Open Water

SHO = Shorelines

PFO = Palustrine Forested

PSS = Palustrine Scrub-Shrub

PEM = Palustrine Emergent

WM = Wet Meadow

PAB = Palustrine Aquatic Bed

VP = Vernal Pool

SW = Softwood Forests

MW = Mixed Forests

HW = Hardwood Forests

OF = Open Fields

AGR = Agricultural Croplands

RES = Residential

Season of Use

B = Breeding

M = Migration

W = Wintering

Y = Year-round

Shading = observed in study area

HIBERNATION

Wood frogs hibernate during winter in terrestrial or forested wetland habitats, never in water. They typically spend the winter in rotten logs, under stumps and rocks, or in shallow burrows. Unlike frog species that hibernate under water, wood frogs are freeze-tolerant and pass the winter with their circulation and respiration stopped and much of their body tissue crystallized into ice. When spring arrives, breathing and heartbeat resume and the frog successfully emerges from hibernation.

HOME RANGE AND TERRITORIALITY

Bellis (1965) studied the summer home range and movements of wood frogs in a northern bog community using mark-recapture methods. He estimated that the mean home range size for adults was 77.2 sq. yds. (695 sq ft), with a range of 3.5 to 440 sq yds. Home range size was not significantly different between males and females. The mean distances between adult recaptures of 12.3 yds (37 ft, range=1 to 78 yds, n=298) suggested that many of the wood frogs remained in a "home area," at least during the summer. Bellis (1965) hypothesized that availability of food was one of the principal factors affecting home range size. His data also suggested that when young-of-the-year wood frogs invaded the study area in July and August, many settled into home areas similar in size to the adults. Many overwinter frogs were captured very near their capture sites from the previous summer, though it was not known whether they simply did not move out of the area seasonally, or that they used their homing ability to return to the home area after moving to hibernation or breeding sites.

Berven and Grudzien (1990) reported that adult wood frogs exhibited a high degree of fidelity to their breeding ponds each year, though they did observe some juveniles dispersing to breeding ponds other than the ones in which they were born.

No information was found in the literature regarding the territoriality of adult wood frogs in

their terrestrial habits. It is thought that frogs in general may defend their shelters against conspecifics (Duellman and Trueb 1994). Male wood frogs are only somewhat territorial in the breeding pools during the brief mating period (see below).

BREEDING

Wood frogs in Massachusetts and other southern New England areas begin their migration from hibernation spots to the breeding pools in early spring (late February to early April), probably stimulated by temperature, relative humidity, and photoperiod (Crouch and Paton 2000, Howard 1980 as cited in Windmiller 1990). They reach the breeding pools shortly after, or concurrent with, the Jefferson salamander, but earlier than the spotted salamanders by a month or more (Pfingsten and Downs 1989). Ice may still be covering portions of the pool when they first arrive. The frogs may be attracted to the breeding sites by a combination of olfactory, auditory, and visual cues, possibly including the duck-like vocalizations of first arrivals, odors of the ponds, humidity gradients, or celestial cues related to the sun and moon (Hunter *et al.* 1999).

In The Primary Study Area: Chronology data on wood frog use of breeding pools during the 1999 Housatonic vernal pool surveys are presented in Figure 2.

Males gather together at a small area of the pond to vocalize and attract females. Males usually outnumber females and must compete for a mate. Because of the shortage of females and the tenacity of males who do successfully locate a mate, only a small percentage of the males will breed. Males are known to prefer the larger females. Coupling is by dorsal amplexus, and fertilization is external. The male releases his sperm into the water as the eggs are expelled from the female. The eggs then become attached to submerged twigs or vegetation. Eggs are generally deposited near shore from 1 to 2 inches below the surface, presumably where water temperatures are more favorable for development of the embryos (Wright and Wright 1949).

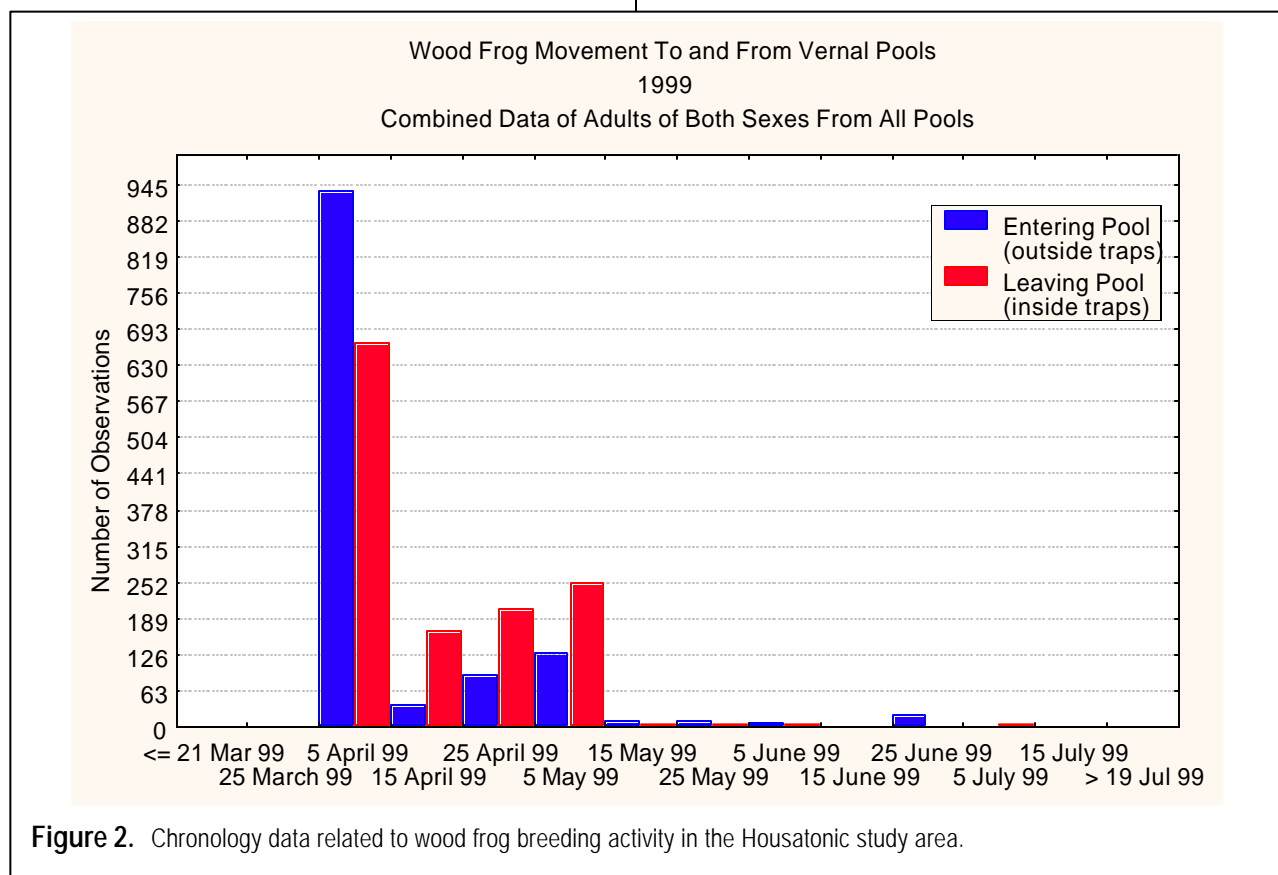
Much of the egg laying is completed in a pond in 4 to 6 days, though it can take over 2 weeks for all egg masses in a pond to be deposited if there are

interruptions caused by fluctuating temperatures (Crouch and Paton 2000, Herreid and Kinney 1967). Each female generally lays only one mass (Crouch and Paton 2000, Waldman 1982 as cited in Gascon and Planas 1986). Crouch and Paton (2000) found a strong correlation between the number of egg masses deposited and the number of male and female wood frogs using a pond.

Individual egg masses or clutches measure 3 to 4 inches in diameter, and may contain on average 2,000 to 3,000 eggs. Clutch size varies from year to year, but has been shown to be larger for younger females and those individuals that are larger in size (Berven 1990). Often, the egg masses from many (up to 100 or more) females are combined into communal masses that may afford survival advantages related to reduced predation, better protection from desiccation, and enhanced thermal properties (Hunter *et al.* 1999). In a Pennsylvania study of abiotic vernal pool parameters, Rowe and Dunson (1993)

reported that the number of wood frog egg masses in their study was positively correlated with dissolved organic carbon. They speculated that this was because wood frog embryos are relatively intolerant to aluminum, which may be bound to a greater extent by the dissolved organics. Gascon and Planas (1986) reported that wood frog egg mass density was negatively correlated with acidity and total organic carbon, that hatching success was inversely correlated with pH, and that the length of the embryonic period was not correlated with any of the chemical parameters studied.

Wood frogs are considered “explosive” breeders, whereby the entire breeding sequence, including arrival at the pools, mating, egg laying, and departure for terrestrial habitats, is completed in a very short time. Though the onset of breeding is variable, its duration (about 1 to 2 weeks) is relatively constant year to year (Berven 1990, Hunter *et al.* 1999). Local tadpole densities in pools can be high, often exceeding 2,000 tadpoles/m² (Biesterfeldt *et al.* 1993, as cited in Petranka *et al.* 1994). Explosive breeding



is thought to be a survival mechanism benefiting the wood frog eggs and tadpoles. By breeding all at once, the hatchling tadpoles emerge within a few days of each other and are of similar size. This has been shown to reduce mortality of eggs and tadpoles due to cannibalism (Hunter *et al.* 1999, Petranka *et al.* 1994). Wood frog tadpoles, like those of other frog species, have also been shown to exhibit kin recognition, where siblings preferentially form tight-knit groups (Roche 1993). These groups swim and feed together, and gain the advantages of increased vigilance for avoiding predators and possibly increased growth rates caused by warmer temperatures within the group.

GROWTH AND DEVELOPMENT

Embryonic development is temperature dependent, with eggs hatching in 10 to 30 days (DeGraaf and Rudis 1983, Hunter *et al.* 1999). Newly hatched wood frog larvae are 0.3 – 0.4 inches in length. Larval development in the wood frog is relatively rapid when compared to other frogs and amphibians, presumably a strategy that allows it to metamorphose before ponds dry (or freeze, as would be the case in the northern part of its range) (Herreid and Kinney 1967). Tadpoles metamorphose in 6 to 15 weeks, but some tadpoles may overwinter in the northern parts of their range (DeGraaf and Rudis 1983, Herreid and Kinney 1967). In Massachusetts, metamorphosis would likely occur from mid-May through early August. In Berven's (1990) 7-year study in Maryland, the initial date that the wood frogs bred varied among years by up to six weeks, and the average length of the larval period ranged from 73 to 113 days (average = 90 to 94). He also found that increased egg numbers were associated with reduced survival, smaller size at metamorphosis, and prolongation of the larval stage.

Newly-metamorphosed juvenile wood frogs are 0.4 – 0.5 inches in length, and resemble adults in color and markings. Large numbers of juveniles typically congregate near the edges of the breeding pools under litter and vegetation before dispersing into surrounding terrestrial areas (Hunter *et al.* 1999). Male wood frogs generally

mature at 1 to 2 years of age, while most females are mature at age two (Duellman and Trueb 1986).

In The Primary Study Area: Metamorphosed wood frogs (juveniles) were observed leaving the study pools beginning in late June and continuing until late July.

FOOD HABITS AND DIET

Foods of the adult wood frog include insects, especially beetles, flies, slugs, snails, spiders, bugs, moth larvae, and earthworms (DeGraaf and Rudis 1983, Hunter *et al.* 1999). Wood frog tadpoles are thought to be mostly herbivorous feeders, consuming algae, decaying plants (detritus), and various microorganisms scraped from aquatic plants present in the breeding pools (Hunter *et al.* 1999).

However, Petranka *et al.* (1994) found that wood frog tadpoles were extremely effective predators of American toad eggs and hatchlings inhabiting the same pool, despite the fact that American toad eggs and larvae are thought to be toxic or distasteful to other organisms. In experimentally induced pairings of the two species, wood frog tadpoles displayed instantaneous and voracious feeding frenzies, where virtually 100% of the toad eggs or young tadpoles ($n = 200 - 3,000$) were consumed in a matter of minutes. The authors also observed this phenomenon in the wild and noted that it is probably rare that American toads successfully breed in ponds containing wood frog tadpoles. The researchers noted that the predation rate appeared to exceed that of any other aquatic predator found in vernal pools in eastern North America. As in other similar studies, Petranka *et al.* (1994) also found that adult toads strongly avoided ovipositing in ponds that contained wood frog tadpoles, choosing instead various less-than-optimal pools or ponds where no wood frogs were present. One hypothesis is that this avoidance behavior may be the result of natural selection pressure, in much the same way that obligate vernal pool amphibians avoid breeding sites that contain fish.

POPULATIONS AND DEMOGRAPHY

Survivorship: Wood frogs are a relatively short-lived vernal pool amphibian, as compared with a species

like the spotted salamander. In a 7-year study of wood frogs in Maryland, Berven (1990) found that the breeding wood frog population fluctuated by a factor of 10 and the juvenile population by a factor of 100, and that variation in adult populations was largely due to variations in juvenile recruitment. Juvenile and adult survivorship was relatively constant among years, regardless of sex. Adult survival was largely independent of age and size.

Age at Maturity and Life Span: Berven (1990) reported that male wood frogs generally matured at one year of age (i.e., 8 months after emerging as juveniles), while females matured at age 2. Approximately 84% of the males bred once, 14% twice, and only 2% bred 3 times. Comparatively, 86.6% of the females bred once, and 14% bred twice. Only 12.6% (average) of the females and 10.8% of males in the studied cohorts survived to breed again as 3 year olds. A small number of male and even fewer female wood frogs were thought to live beyond age 3. The per annum survival rate for males was estimated at 14% as compared with 12.8% for females.

Mortality: Factors contributing to adult and juvenile wood frog mortality are not well understood. Predation, starvation, diseases and parasites, and desiccation during periods of low rainfall all contribute to wood frog mortality, but other density-dependent and density-independent factors play a roll in survivorship and overall population regulation (Berven 1990). For the wood frog, these factors appear to be interrelated, and include fecundity, larval and adult density, timing of metamorphosis, size at metamorphosis, fluctuations in adult population size, rainfall, and pond productivity and duration among others.

Enemies: Wood frogs have few defenses and are preyed upon by many other animals. In breeding habitats, adults fall prey to water snakes, snapping turtles, herons, mink, raccoon, skunk, fox, and coyote. The eggs and juveniles are fed upon by leeches, caddisfly, mayfly, and dragonfly larvae, predaceous diving beetles, salamanders, adult frogs and toads, turtles,

snakes, birds, and various carnivorous mammals (Hunter *et al.* 1999, Whitlock *et al.* 1994).

STATUS

General: The wood frog is common in suitable habitat throughout Massachusetts and has been found to be one of the most abundant amphibians in the Northeast in forested habitats (DeGraaf and Rudis 1983, DeGraaf and Rudis 1990, deMaynadier and Hunter 1998). It is currently not a listed species in Massachusetts or other New England States. The wood frog is considered an obligate vernal pool species, and as with other amphibians whose life histories are tied to vernal pool habitats, this species faces continual and cumulative pressure from development as vernal pools and their surrounding upland forests are impacted by ongoing development.

In The Primary Study Area: Wood frogs were by far the most common amphibian species observed during the vernal pool surveys in 1999. Approximately 1,300 wood frogs were caught as they entered the four vernal pools in the study, as compared to 154 leopard frogs, 87 green frogs, and 70 spotted salamanders. Figure 3 below illustrates the locations within the primary study area where wood frogs were observed during the 1998, 1999, and 2000 field studies.

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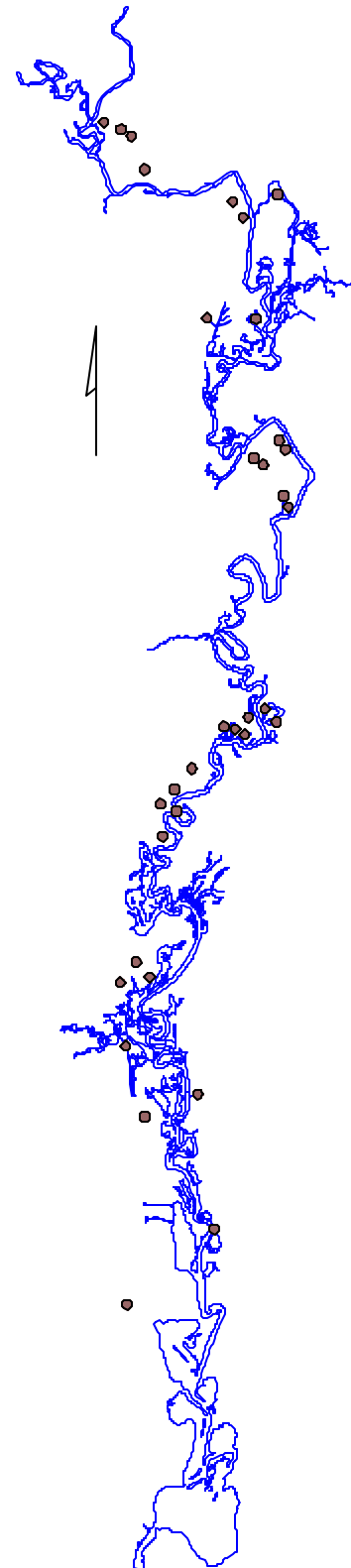


Figure 3. Wood frog sightings in the primary study area, from 1998 – 2000 field studies

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